

What is Claimed is:

1. A system for visualizing conductivity and current density distributions comprising:

5 a plurality of current injecting devices for injecting currents into a measuring object;

an MRI scanner for measuring one directional component of a magnetic flux density due to each of the currents injected into a measuring object;

an operating part for controlling the current injecting devices so as to inject currents of different directions into the measuring object, and calculating a conductivity distribution and a current density distribution inside of the measuring object by using the one directional component of a magnetic flux density; and

displaying means for visualizing the conductivity and current density distributions calculated by the operating part.

15 2. The system as claimed in claim 1, wherein the current injecting device includes;

an electrode,

an insulating container with the electrode attached to one side, the insulating container having an electrolyte substance, and

20 a wire for supplying the current to the electrode.

3. The system as claimed in claim 1, wherein the operating part controls the current injecting devices such that one pair of the current injecting devices are selected in succession, and the selected pair of the current injecting devices supply

the current to the measuring object.

4. The system as claimed in claim 1, wherein the operating part calculates an inside voltage and a surface voltage of the measuring object for a first conductivity,  
5 and calculates a second conductivity by using the inside voltage and the one directional component of the magnetic flux density.

5. The system as claimed in claim 4, wherein the operating part multiplies or divides a constant to the second conductivity according to a ratio of a calculated  
10 surface voltage to a measured surface voltage.

6. The system as claimed in claim 4, wherein, if an absolute value of a difference of the first conductivity and the second conductivity is greater than a preset value, the operating part calculates the inside voltage and the surface voltage  
15 for the second conductivity, and calculates a third conductivity by using the inside voltage for the second conductivity and the one directional component of the magnetic flux density.

7. The system as claimed in claim 4, wherein the operating part determines  
20 that the second conductivity is a true conductivity, if the absolute value of the difference of the first conductivity and the second conductivity is smaller than the present value.

8. The system as claimed in claim 4, wherein the operating part substitutes

the inside voltage and the one direction component of the magnetic flux density into the following equation, and subjects the equation to a line integral, to obtain the second conductivity.

$$\frac{1}{\mu_0} \begin{bmatrix} \nabla^2 B_z^1 \\ \vdots \\ \nabla^2 B_z^N \end{bmatrix} = \begin{bmatrix} \frac{\partial V^1}{\partial y} & -\frac{\partial V^1}{\partial x} \\ \vdots & \vdots \\ \frac{\partial V^N}{\partial y} & -\frac{\partial V^N}{\partial x} \end{bmatrix} \begin{bmatrix} \frac{\partial \sigma}{\partial x} \\ \frac{\partial \sigma}{\partial y} \end{bmatrix}$$

5 Where,  $\mu_0$  denotes a magnetic permeability of the free space.

9. The system as claimed in claim 4, wherein the operating part substitutes the inside voltage and the one directional component of the magnetic flux density into the following equation, and solves the equation by layer potential method, to  
10 obtain the second conductivity.

$$\frac{1}{\mu_0} \begin{bmatrix} \nabla^2 B_z^1 \\ \vdots \\ \nabla^2 B_z^N \end{bmatrix} = \begin{bmatrix} \frac{\partial V^1}{\partial y} & -\frac{\partial V^1}{\partial x} \\ \vdots & \vdots \\ \frac{\partial V^N}{\partial y} & -\frac{\partial V^N}{\partial x} \end{bmatrix} \begin{bmatrix} \frac{\partial \sigma}{\partial x} \\ \frac{\partial \sigma}{\partial y} \end{bmatrix}$$

Where,  $\mu_0$  denotes a magnetic permeability of the free space.

10. A method for visualizing conductivity and current density distributions  
15 comprising the steps of:

(a) injecting currents of different directions into a measuring object through current injecting devices attached to a surface of the measuring object;

(b) measuring one directional component of a magnetic flux density of due to each of the currents injected into an inside of the measuring object;

(c) calculating a conductivity and a current density of the inside of the measuring object by using the measured one directional component of the magnetic flux density; and

(d) visualizing the conductivity and the current density.

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11. The method as claimed in claim 10, wherein the step (a) includes the steps of;

selecting a pair of the current injecting devices in succession, and

injecting the currents into the measuring object in succession through the

10 selected pair of the current injecting devices.

12. The method as claimed in claim 10, wherein the step (c) includes the steps of;

calculating the inside voltage and the surface voltage of the measuring object  
15 for a first conductivity, and

calculating a second conductivity by using the calculated inside voltage and one directional components of the magnetic flux density.

13. The method as claimed in claim 12, wherein the step (c) further includes  
20 the step of multiplying or dividing the second conductivity by a constant according to a ratio of the calculated surface voltage and a measured surface voltage of the measuring object.

14. The method as claimed in claim 12, wherein the step (c) further includes

the steps of;

calculating an absolute value of a difference of the first conductivity and the second conductivity, and

comparing the absolute value of the difference to a preset value.

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15. The method as claimed in claim 14, wherein the step (c) further includes the steps of;

calculating the inside voltage and the surface voltage of the measuring object for the second conductivity if the absolute value of the difference of the first  
10 conductivity and the second conductivity is greater than a preset value, and

calculating a third conductivity by using the inside voltage for the second conductivity and the measured one directional component of the magnetic flux density.

15 16. The method as claimed in claim 14, wherein the step (c) further includes the steps of determining the second conductivity being a true conductivity, if the absolute value of the difference of the first conductivity and the second conductivity is smaller than the preset value.

20 17. The method as claimed in claim 12, wherein the step of calculating a second conductivity by using the calculated inside voltage and the measured one directional components of the magnetic flux density includes the steps of;

substituting the inside voltage and the one directional component of the magnetic flux density into the following equation, and

subjecting the equation to a line integral, to obtain the second conductivity.

$$\frac{1}{\mu_0} \begin{bmatrix} \nabla^2 B_z^1 \\ \vdots \\ \nabla^2 B_z^N \end{bmatrix} = \begin{bmatrix} \frac{\partial V^1}{\partial y} & -\frac{\partial V^1}{\partial x} \\ \vdots & \vdots \\ \frac{\partial V^N}{\partial y} & -\frac{\partial V^N}{\partial x} \end{bmatrix} \begin{bmatrix} \frac{\partial \sigma}{\partial x} \\ \frac{\partial \sigma}{\partial y} \end{bmatrix}$$

Where,  $\mu_0$  denotes a magnetic permeability of the free space.

- 5            18. The method as claimed in claim 12, wherein the step of calculating a second conductivity by using the calculated inside voltage and the measured one directional components of the magnetic flux density includes the steps of;

substituting the inside voltage and the one directional component of the magnetic flux density into the following equation, and

- 10           solving the equation by layer potential method, to obtain the second conductivity.

$$\frac{1}{\mu_0} \begin{bmatrix} \nabla^2 B_z^1 \\ \vdots \\ \nabla^2 B_z^N \end{bmatrix} = \begin{bmatrix} \frac{\partial V^1}{\partial y} & -\frac{\partial V^1}{\partial x} \\ \vdots & \vdots \\ \frac{\partial V^N}{\partial y} & -\frac{\partial V^N}{\partial x} \end{bmatrix} \begin{bmatrix} \frac{\partial \sigma}{\partial x} \\ \frac{\partial \sigma}{\partial y} \end{bmatrix}$$

Where,  $\mu_0$  denotes a magnetic permeability of the free space.

- 15           19. The method as claimed in claim 10, wherein the step (c) includes the steps of;

calculating an initial inside voltage for any preset initial conductivity,

calculating a conductivity by using the calculated initial inside voltage and the measured one directional component of the magnetic flux density, and

calculating the current density of the inside of the measuring object by using the calculated conductivity and the inside voltage of the measuring object for the conductivity.

- 5           20. The method as claimed in claim 19, wherein the step (c) further includes the step of comparing the inside voltage in a previous step and the inside voltage of the measuring object for the conductivity.